CLAIMS

1. A semiconductor light-emitting device comprising:

a substrate including a substrate surface positioned along a substrate surface plane;

a crystal layer including a crystal surface oriented along a crystal surface plane diagonally intersecting the substrate surface plane; and

a first conductive layer, an active layer, and a second conductive layer each formed along at least a portion of the crystal surface.

2. The semiconductor light-emitting device as claimed in claim 1, wherein the crystal layer comprises a wurtzite crystal structure.

3. The semiconductor light-emitting device as claimed in claim 1, wherein the crystal layer is composed of a nitride semiconductor material.

4. The semiconductor light-emitting device as claimed in claim 1, wherein the crystal layer is formed by selective growth on the substrate with a material layer capable of growth interposed therebetween.

5. The semiconductor light-emitting device as claimed in claim 4, wherein the material layer capable of growth is selectively removed during selective growth to form the crystal layer.

6. The semiconductor light-emitting device as claimed in claim 4, wherein the semiconductor light-emitting device further comprises a masking layer having an opening through which the crystal layer is selectively grown.

7. The semiconductor light-emitting device as claimed in claim 6, wherein the crystal layer is formed by selective growth such that the crystal layer extends laterally from the opening in the masking layer.

8. The semiconductor light-emitting device as claimed in claim 1, wherein the substrate plane comprises a C-plane.

9. The semiconductor light-emitting device as claimed in claim 1, wherein the crystal surface plane comprises at least one of a S-plane and a (11-22) plane.

10. The semiconductor light-emitting device as claimed in claim 1, wherein the crystal surface plane comprises a plane having a plane orientation inclined at an angle ranging from about 5 to about 6 degrees with respect to at least one of a S-plane and a (11-22) plane.

11. The semiconductor light-emitting device as claimed in claim 1, wherein a current is injected into the active layer.

12. The semiconductor light-emitting device as claimed in claim 1, wherein the active layer comprises InGaN.

13. The semiconductor light-emitting device as claimed in claim 1, wherein the crystal layer comprises a substantially symmetrical hexagonal structure.

14. The semiconductor light-emitting device as claimed in claim 1, wherein a portion of the crystal surface is oriented along a C-plane and positioned centrally along the crystal structure with respect to a second portion of the crystal surface that is oriented along the crystal surface plane which diagonally intersects the substrate surface plane.

15. An image display unit comprising:

a plurality of semiconductor light-emitting devices arranged so as to emit light in response to a signal, each of the semiconductor light-emitting devices comprising a substrate including a substrate surface positioned along a substrate surface plane, a crystal layer including a crystal surface oriented along a crystal surface plane diagonally intersecting the substrate surface plane, and a first conductive layer, an active layer, and a second conductive layer each formed along at least a portion of the crystal surface.

16. A lighting system comprising:

a plurality of semiconductor light-emitting devices, each of the semiconductor light-emitting devices comprising a substrate including a substrate surface positioned along a substrate surface plane, a crystal layer including a crystal surface oriented along a crystal surface plane diagonally intersecting the substrate surface plane, and a first conductive layer, an active layer, and a second conductive layer each formed along at least a portion of the crystal surface.

17. The lighting system as claimed in claim 16, wherein each of the semiconductor light-emitting devices are arranged so as to emit light in response to an identical signal.

18. A process for producing a semiconductor light-emitting device, the process comprising the steps of:

providing a substrate including a substrate surface oriented along a substrate surface plane;

forming a crystal seed layer on the substrate surface;

forming a masking layer on the crystal seed layer, wherein the masking layer includes an opening;

forming a crystal layer by selective growth of the crystal seed layer through the opening of the masking layer, wherein the crystal layer includes a crystal layer surface oriented along a crystal layer plane that diagonally intersects the substrate surface; and

forming each of a first conductive layer, an active layer, and a second conductive layer along at least a portion of the crystal layer surface.

19. The process as claimed in claim 18, wherein the substrate surface plane comprises a C-plane.

20. The process as claimed in claim 18, further comprising the step of forming a plurality of semiconductor light-emitting devices spaced apart along the substrate.

21. The process as claimed in claim 20, further comprising the step of forming an electrode on at least a side of each semiconductor light-emitting device.

22. A semiconductor light-emitting device comprising:

a substrate including a substrate surface positioned along a substrate surface plane;

a crystal layer including a crystal layer surface oriented along a crystal surface plane defined as a S-plane which diagonally intersects the substrate surface plane;

and a layer of a first conductivity type, an active layer, and a layer of a second conductivity type each formed along the S-plane.

23. The semiconductor light-emitting device as claimed in claim 22, wherein the crystal layer comprises a wurtzite crystal structure.

24. The semiconductor light-emitting device as claimed in claim 22, wherein the crystal layer is composed of a nitride semiconductor material.

25. The semiconductor light-emitting device as claimed in claim 22, wherein the crystal layer is formed by selective growth on the substrate with a material layer capable of growth interposed therebetween.

26. The semiconductor light-emitting device as claimed in claim 25, wherein the material layer capable of growth is selectively removed during selective growth to form the crystal layer.

27. The semiconductor light-emitting device as claimed in claim 25, wherein the semiconductor light-emitting device further comprises a masking layer having an opening through which the crystal layer is selectively grown.

28. The semiconductor light-emitting device as claimed in claim 27, wherein the crystal layer is formed by selective growth such that the crystal layer extends laterally from the opening in the masking layer.

29. The semiconductor light-emitting device as claimed in claim 22, wherein the substrate surface plane comprises a C+ plane.

30. The semiconductor light-emitting device as claimed in claim 22, wherein a current is injected into the active layer.

31. A semiconductor light-emitting device comprising:

a substrate including a substrate surface positioned along a substrate surface plane;

a crystal layer comprising an approximately hexagonal pyramid, having a face oriented along an S-plane that diagonally intersects the substrate surface plane; and

a layer of a first conductivity type, an active layer, and a layer of a second conductivity type each formed along at least a portion of the approximately hexagonal pyramid.

32. The semiconductor light-emitting device as claimed in claim 31, wherein a current is injected into the active layer such that a current density is lower near or at an apex of the approximately hexagonal pyramid than in the face of the approximately hexagonal pyramid.

33. A semiconductor light-emitting device comprising:

a substrate including a substrate surface positioned along a substrate surface plane;

a crystal layer comprising an approximately hexagonal prismoid, having a face oriented about an S- plane, and a top region oriented about a C-plane; and

a layer of a first conductivity type, an active layer, and a layer of a second conductivity type each formed along at least a portion of the approximately hexagonal prismoid.

34. An image display unit comprising:

a plurality of semiconductor light-emitting devices arranged so as to emit light in response to a signal, each of the semiconductor light-emitting devices comprising a substrate including a substrate surface positioned along a substrate surface plane, a

crystal layer including a crystal surface oriented along a crystal surface plane defined as a S-plane which diagonally intersects the substrate surface plane, and a first conductive layer, an active layer, and a second conductive layer each formed along at least a portion of the crystal surface.

35. A lighting system comprising:

a plurality of semiconductor light-emitting devices, each of the semiconductor light-emitting devices comprising a substrate including a substrate surface positioned along a substrate surface plane, a crystal layer including a crystal surface oriented along a crystal surface plane defined as a S-plane which diagonally intersects the substrate surface plane, and a first conductive layer, an active layer, and a second conductive layer each formed along at least a portion of the crystal surface.

36. The lighting system as claimed in claim 35, wherein each of the semiconductor light-emitting devices are arranged so as to emit light in response to an identical signal.

37. A process for producing a semiconductor light-emitting device, the process comprising the steps:

providing a substrate including a substrate surface oriented along a substrate surface plane;

forming a masking layer on the substrate, wherein the masking layer includes an opening;

forming a crystal layer by selective growth through the opening of the masking layer, wherein the crystal layer includes a crystal layer surface oriented along a crystal layer plane defined as a S-plane which diagonally intersects the substrate surface plane; and

forming each of a first conductive layer, an active layer, and a second conductive layer along at least a portion of the crystal layer surface.

38. The process for producing a semiconductor light-emitting device as claimed in claim 37, wherein the substrate surface plane comprises a C+ plane.

39. The process for producing a semiconductor light-emitting device as claimed in claim 37, further comprising the steps of:

forming a plurality of the semiconductor light-emitting devices on the substrate; and

separating the plurality of semiconductor light-emitting devices.

40. The process for producing a semiconductor light-emitting device as claimed in claim 39, wherein each separated semiconductor light-emitting device comprises at least one electrode formed on a side.

41. A semiconductor light-emitting device comprising:

a substrate including a substrate surface positioned along a substrate surface plane;

a crystal grown layer formed by selective growth and including a crystal surface oriented along a crystal surface plane diagonally intersecting the substrate surface plane;

an active layer which is formed along at least a portion of the crystal grown layer that emits light upon injection of an amount of current;

and a reflecting region which is formed substantially parallel to the crystal surface plane and reflects at least a portion of the light emerging from the active layer.

42. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer is formed from a compound semiconductor having a wurtzite crystal structure.

43. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer is approximately parallel to the crystal surface plane.

44. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer is approximately parallel to a S-plane.

45. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer is approximately parallel to a plane having a plane orientation

inclined at an angle ranging from about 5 to about 6 degrees with respect to at least one a S-plane and a (11-22) plane.

46. The semiconductor light-emitting device as claimed in claim 41, wherein the reflecting region comprises at least two reflecting planes that intersect at an angle less than 180°.

47. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer is formed from a nitride compound semiconductor.

48. The semiconductor light-emitting device as claimed in claim 47, wherein the active layer is formed from a gallium nitride compound semiconductor.

49. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer contains In.

50. The semiconductor light-emitting device as claimed in claim 41, wherein the active layer is separated for each device.

51. The semiconductor light-emitting device as claimed in claim 41, further comprising an underlying layer formed on the substrate, wherein the selective growth of the crystal grown layer is derived from the underlying layer.

52. A process for producing a semiconductor light-emitting device, the process comprising the steps of:

providing a substrate including a substrate surface oriented along a substrate surface plane;

selectively growing a crystal layer including a crystal surface oriented along a crystal surface plane diagonally intersecting the substrate surface plane;

forming an active layer approximately parallel to the crystal surface plane; and

forming a reflecting region substantially parallel to the crystal surface plane.

53. A semiconductor light-emitting device comprising:

a substrate including a substrate surface oriented along a substrate surface plane;

a first grown layer including a first grown layer conductivity type formed on the substrate;

a masking layer formed on the first grown layer;

a second grown layer of a second grown layer conductivity type formed by selective growth through an opening in the masking layer and including a crystal surface oriented along a crystal surface plane;

a first cladding layer including a first cladding layer conductivity type formed along at least a portion of the crystal surface plane;

an active layer; and

a second cladding layer including a second cladding layer conductivity type, wherein at least one of the first cladding layer, the active layer, and the second cladding layer cover the masking layer surrounding the opening.

54. The semiconductor light-emitting device as claimed in claim 53, wherein the first grown layer conductivity type, the second grown layer conductivity type, and the first cladding layer conductivity type comprise a first conductivity type and the second cladding layer conductivity type comprises a second conductivity type.

55. The semiconductor light-emitting device as claimed in claim 53, wherein the crystal surface plane of the second grown layer diagonally intersects the substrate surface plane.

56. The semiconductor light-emitting device as claimed in claim 53, wherein the first and second grown layers comprise a wurtzite crystal structure.

57. The semiconductor light-emitting device as claimed in claim 53, wherein the second grown layer is composed of a nitride semiconductor.

58. The semiconductor light-emitting device as claimed in claim 53, wherein the substrate surface plane is a C-plane.

59. A semiconductor light-emitting device comprising:

a substrate;

a first grown layer including a first grown layer conductivity type formed on the substrate;

a masking layer formed on the first grown layer;

a second grown layer including a second grown layer conductivity type formed by selective growth through an opening in the masking layer and including a crystal surface oriented along a crystal surface plane;

a first cladding layer including a first cladding layer conductivity type formed along at least a portion of the crystal surface plane;

an active layer; and

a second cladding layer including a second cladding layer conductivity type, wherein the first cladding layer, the active layer, and the second cladding layer are formed as to substantially cover the second grown layer.

60. The semiconductor light-emitting device as claimed in claim 59, wherein the first grown layer conductivity type, the second grown layer conductivity type, and the first cladding layer conductivity type comprise a first conductivity type and the second cladding layer conductivity type comprises a second conductivity type.

61. A semiconductor light-emitting device comprising:

a substrate;

a first grown layer of a first grown layer conductivity type formed on the substrate;

a masking layer formed on the first grown layer;

a second grown layer of a second grown layer conductivity type formed by selective growth through an opening in the masking layer and including a crystal surface oriented along a crystal surface plane;

a first cladding layer of a first cladding layer conductivity type formed along at least a portion of the crystal surface plane;

an active layer; and

a second cladding layer of a second cladding layer conductivity type, wherein the first cladding layer, the active layer, and the second cladding layer are formed

substantially parallel to the crystal surface plane such that an end region of at least one of the first cladding layer, the active layer, and the second cladding layer contacts the masking layer.

62. The semiconductor light-emitting device as claimed in claim 61, wherein the first grown layer conductivity type, the second grown layer conductivity type, and the first cladding layer conductivity type comprise a first conductivity type and the second cladding layer conductivity type comprises a second conductivity type.

63. An image display unit comprising:

a plurality of semiconductor light-emitting devices arranged so as to emit light in response to a signal, each of the semiconductor light-emitting devices comprising a substrate, a first grown layer of a first conductivity type formed on the substrate, a masking layer formed on the first grown layer, a second grown layer of the first conductivity type formed by selective growth through an opening in the masking layer and including a crystal surface oriented along a crystal surface plane, a first cladding layer of the first conductivity type formed along at least a portion of the crystal surface plane, an active layer, and a second cladding layer of a second conductivity type, wherein the first cladding layer, the active layer, and the second cladding layer are formed substantially parallel to the crystal surface plane such that an end region of at least one of the first cladding layer, the active layer, and the second cladding layer extends to the masking layer in proximity to the opening.

64. A lighting system comprising:

a plurality of semiconductor light-emitting devices, each of the semiconductor light-emitting devices comprising a substrate, a first grown layer including a first conductivity type formed on the substrate, a masking layer formed on the first grown layer, a second grown layer including the first conductivity type formed by selective growth through an opening in the masking layer and including a crystal surface oriented along a crystal surface plane, a first cladding layer including the first conductivity type formed along at least a portion of the crystal surface plane, an active layer, and a second cladding layer of a second conductivity type, wherein the first cladding layer, the active layer, and the second cladding layer are formed substantially

parallel to the crystal surface plane such that an end region of at least one of the first cladding layer, the active layer, and the second cladding layer extends to the masking layer in proximity to the opening.

65. The lighting system as claimed in claim 64, wherein each of the semiconductor light-emitting devices are arranged so as to emit light in response to an identical signal.

66. A process for producing a semiconductor light-emitting device, the process comprising the steps of:

providing a substrate including a substrate surface oriented along a substrate surface plane;

forming a first grown layer on the substrate;

forming a masking layer having an opening on the first grown layer;

selectively growing a second grown layer through the opening in the masking layer, wherein the second grown layer includes a crystal surface oriented along a crystal surface plane; and

forming a cladding layer of a first conductivity type, an active layer, and a cladding layer of a second conductivity type each substantially parallel to the crystal surface plane extending to the masking layer in proximity of the opening.

67. The process for producing a semiconductor light-emitting device as claimed in claim 66, wherein the crystal surface plane of the second grown layer diagonally intersects the substrate surface plane.

68. A semiconductor light-emitting device comprising:

a substrate including a substrate surface oriented along a substrate surface plane; and

an active layer formed along at least a portion of a selectively grown crystal layer via a window region along the substrate surface plane such as to be disposed between a first conductive layer and a second conductive layer and oriented along an active layer plane that is not parallel to the substrate surface plane, and wherein an area of the active layer is larger than at least one of an area of the window region and a

projected area of the crystal layer derived from projecting the crystal layer to the substrate surface plane in a normal direction.

69. The semiconductor light-emitting device as claimed in claim 68, wherein the active layer comprises a compound semiconductor having a wurtzite crystal structure.

70. The semiconductor light-emitting device as claimed in claim 69, wherein the active layer is substantially parallel to a S-plane.

71. The semiconductor light-emitting device as claimed in claim 70, wherein the active layer is formed such that it extends laterally from the window region.

72. The semiconductor light-emitting device as claimed in claim 68, further comprising:

a first electrode connected to the first conductive layer; and

a second electrode connected to the second conductive layer, wherein the first electrode and second electrode are capable of injecting current into the active layer.

73. The semiconductor light-emitting device as claimed in claim 68, wherein the active layer comprises a nitride compound semiconductor.

74. The semiconductor light-emitting device as claimed in claim 73, wherein the active layer comprises a gallium nitride compound semiconductor.

75. The semiconductor light-emitting device as claimed in claim 68, wherein the active layer comprises In.

76. The semiconductor light-emitting device as claimed in claim 68, further comprising a plurality of semiconductor light-emitting devices selectively grown such that the active layer of each semiconductor light-emitting device is separated from the active layer of adjacent semiconductor light-emitting devices.

77. A semiconductor light-emitting device as claimed in claim 68, wherein the selective growth is derived from an underlying layer formed on the substrate.

78. A semiconductor light-emitting device comprising

a substrate including a substrate surface oriented along a substrate surface plane; and

an active layer formed by selective growth such as to be disposed between a first conductive layer and a second conductive layer and oriented along an active layer plane that is not parallel to the substrate surface plane, and wherein a portion of the active layer is directed away from the active layer plane towards the substrate.

79. A semiconductor light-emitting device comprising:

a substrate including a substrate surface oriented along a substrate surface plane; and

an active layer formed along at least a portion of a selectively grown crystal layer such as to be disposed between a first conductive layer and a second conductive layer and oriented along an active layer plane that is not parallel to the substrate surface plane, and wherein an area of the active layer greater than or equal to a sum of a projected area of the crystal layer derived from projecting the crystal layer to the substrate in a normal direction and an area in which at least one of the conductive layers contacts a respective electrode formed on the substrate.

80. A process for producing a semiconductor light-emitting device, the process comprising the steps of:

forming an underlying layer on a substrate;

forming a masking layer having a window region on the underlying layer;

selectively growing a crystal grown layer through the window region; and

forming a first conductive layer, an active layer, and a second conductive layer on a surface of the crystal grown layer, wherein the active layer includes a crystal surface with a surface area larger than a projected area derived from projecting the crystal surface toward the substrate in a normal direction.

81. A process for producing a semiconductor light-emitting device, the process comprising the steps of:

providing a first substrate including a first substrate surface oriented along a first substrate surface plane;

forming a crystal seed layer on the first substrate surface;

forming a masking layer on the crystal seed layer, wherein the masking layer includes an opening;

forming a crystal layer by selective growth of the crystal seed layer through the opening of the masking layer, wherein the crystal layer includes a crystal layer surface oriented along a crystal layer plane that diagonally intersects the first substrate surface plane;

forming each of a first conductive layer, an active layer, and a second conductive layer along at least a portion of the crystal layer surface;

embedding each of the first conductive layer, the active layer and the second conductive layer and the second conductive layer in a resin material layer formed on a second substrate;

removing the second substrate by laser abrasion;

separating the crystal seed layer and masking layer from a substrate region of the substrate; and

forming an electrode on at least a portion of the substrate region.

82. The method as claimed in 81, wherein the crystal seed layer and the masking layer are separated by peeling off.